

## FISH POPULATION FROM KLOKOT AND KRUSNICA RIVERS

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### POPULACIJE RIBA RIJEKA KLOKOT I KRUSNICA

#### *Apstrakt*

Vode unsko-sanskog kantona spadaju u slabije istražena područja u Bosni i Hercegovini sa aspekta ihtiofaune, a to se pogotovo odnosi na pritoke Une. Uzevši u obzir činjenicu da je ihtiološko ispitivanje ribljih populacija lijeve pritoke Une - Klokot i desne pritoke Une - Krušnica, važno za ovo područje, provedna su istraživanja tokom dvije sezone, i to jesen - zima 2001. godine i proljeće - ljeto 2002. godine. Istražen je kvalitet i kvantitet izlovljenih ihtipopulacija ova dva vodena biotopa. U istraživanjima je primjenjeno standardno ribolovno oruđe, elektroagregat i mreže. Dio izlovljenog materijala se direktno ispitivao na terenu, a veći dio je fiksiran i prenesen u laboratorij Biotehničkog fakulteta, Univerziteta u Bihaću. Ispitivanja osnovnih pokazatelja kvalitativnog i kvantitativnog sastava ihtiofaune rijeke Klokot i Krušnice provedena su na tri lokaliteta (izvor, srednji tok i ušće) na njihovom longitudinalnom profilu. U rijeci Klokot ukupno je izlovljeno 287 jedinki deset vrsta riba koje su raspoređene u pet familija, a u rijeci Krušnici 108 jedinki osam vrsta riba takođe zastupljenih u istih pet familija: *Salmonidae*, *Thymallidae*, *Cyprinidae*, *Esocidae* i *Cottidae*.

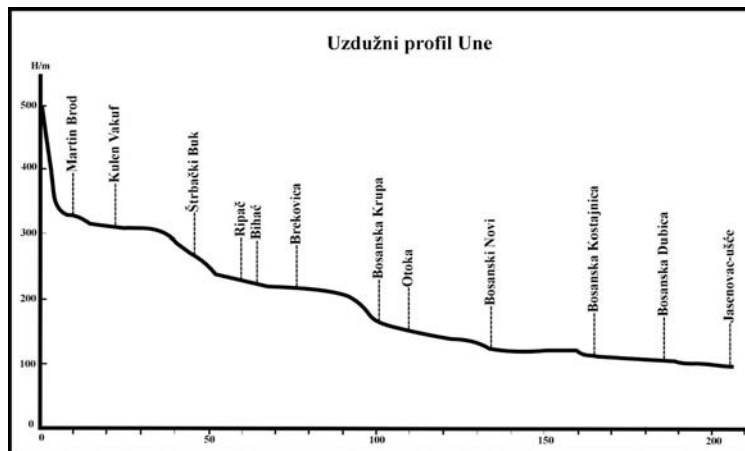
*Ključne riječi: populacija, ribe, rijeka*

*Keywords: population, fish, river*

#### INTRODUCTION

Hydrographic and geological characteristics in the area of basin of river Una are partly examined, which is positive, but, waters of Una-Sana basin belong to less researched areas in terms of ichthyofauna in Bosnia and Herzegovina. These water systems are interesting to explore both ichthyofauna and other characteristics such as quality of ecosystem, and biodiversity of flora and fauna. River Una springs bellow mountain Černica and hill Lisina in the village of Donja Suvaja. The length of river flow is 210,35 kilometers. In the upper

course, from the river spring to Bihać (69,63 km), river has the features of a real mountain river. From Bihać to Bos. Novi (72,78 km) river has characteristics of hill river, and on the area from Bos. Novi to rivermouth (67,94 km) the river Una is a lowland river. Una flows into Sava River near Jasenovac on 95 meters above sea level. The most important right tributaries of river Una are Unac, Krušnica and Sana. After these three rivers, there are two more tributaries: Mlječanica and Moštanica, while the most important left tributaries of river are Klokot and Žiravac (Spahić, 1991; Alagić i sar., 1994; IBG, 2003). In addition to the above mentioned tributaries, significant amounts of water, especially in periods of intense rainfall, Una receives water from several big border-land sources along the flow, of which the richest with water are sources in the area of Kulen Vakuf. River Klokot springs near Bihać in the foothills of the mountain Plješevica, around 5 kms of the city, and represents the biggest water well for supplying the population of Bihać with drinking water. Length of the river is 6 km, the average width 18-22 m, and the depth of 5-7 m. Along the river course, riverbed is incised into the diluvial and alluvial deposits. River flow direction is from west to east and represents the boundary of the upper and middle course of the river Una. The rivermouth of Klokot into Una is located 1 km downstream of the town Bihać.



**Figure 1.** The longitudinal profile of river Una (Sofradžija et al., 2002)

River Krušnica springs around village Gudavac in municipality Bosanska Krupa, at the foot of the mountain of Grmeč. River springs in the cave in which waters of Grmeč and surrounding hills are collected. The length of river is 6,8 km, average width is 20 m, and average depth varies from 5 to 7 m. The width of Krušnica on the rivermouth is 15 m. It springs on 200 m above sea level, and rivermouth of Una is located on 140 m above sea level (DMA, 1994), so the difference in sea level along the course is of 60 m (Ajanović, 1999). Krušnica is right tributary in the middle part of Una's flow and represents oasis of ecology preservation in area of municipality Bosanska Krupa. With its tributary, Una belongs to Black Sea basin, and fish populations which settle this area are spread wider in Europe. There are no endemic species of fish in Una's basin, but it doesn't diminish the importance of study of fish populations of river Una, and especially its smaller tributaries which are interesting from the aspect of applicative fisheries. This fact particularly refers to Klokot, left Krušnica, right tributary of river Una, which attracts great significance recently. There is fish farm on the river Klo-

kot, where trout is reared and grayling is spawned. Taking into account all mentioned above, we consider that it is very important and useful to determine real state of fish populations in this two tributaries. With the realization of this goal we would have complete insight about the composition of fish populations of these two tributaries of river Una, which would create a solid basis for the completion of knowledge about the diversity of ichthyofauna of aquatic ecosystems of Una - Sana Canton. Introduction of fish populations of particular area is significant for fishing, but also from the aspect of protection of. In the spotlight of this work the following aims are set: to determine the qualitative and quantitative composition of ichthyopopulations in three localities (source, flow and the rivermouth) at longitudinal profile of Klokot and Krušnica. 4 families are present in the River Krušnica: *Salmonidae*, *Thymallus*, *Cyprinidae* and *Cottidae* ('UNA I' 1984). Family of *Salmonidae* family is represented with 2 species and they are *Salmo trutta fario* and *Hucho hucho*. *Thymallus thymallus* represents family *Thymallidae*. From *Cyprinidae* family 4 species are registered, and they are: *Chondrostoma nasus*, *Leuciscus cephalus*, *Barbus barbus* and *Rutilus pigus virgo*. Only one species from the *Esocidae* family is found: *Esox lucius*. In Klokot River, according to the same literature data as for Krušnica, in period August-October 1984, families *Salmonidae*, *Thymallidae*, *Cyprinidae* i *Esocidae* are registered.

## MATERIALS AND METHODS

A detailed field study of river Klokot, and river Krušnica have been done during two seasons. First field was done in October -November 2001, and second at the end of May, 2002. To determine the qualitative and quantitative composition of ichthyopopulations on longitudinal profile of these rivers, three localities were selected: spring, middle flow and rivermouth. Sampling was done using nets and electrical aggregates. Gillnets, seine net type with mesh diameter of 10-36 mm, are used for sampling. Nets were placed in the evening and taken out in the early morning at middle flow and rivermouth. Sampling at the river spring was carried out using electrical aggregate „Honda” EZ 2.200, volume 2kV and electrical aggregate „ELT 61 II” 300/500 V, while fish net with mesh diameter 3x3 was also used. During the study, a smaller number of individuals of fish were processed on the field, while the largest number of collected material was fixed in 4% formalin and transferred into laboratory of Biotechnical Faculty for further analysis. Fish determination was done according to Vuković i Ivanović (1971). The results of researches were statistically processed according to Petz (1985).

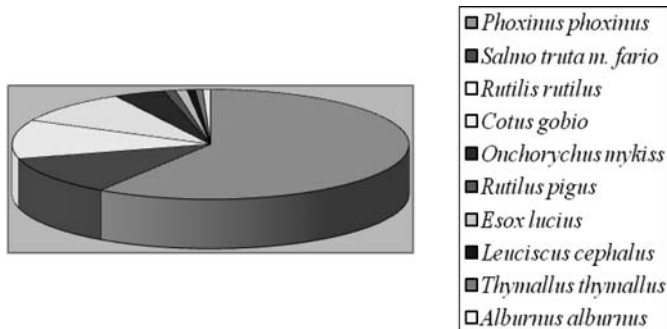
## RESULTS AND DISCUSSIONS

Ichthyological studies of rivers Klokot and Krušnica were conducted in three localities of each river during two seasons and resulted in the following number of caught individuals: river Klokot - 287, river Krušnica - 108. In river Klokot in the season autumn-winter 2001, 237 individuals were caught while in the season spring-summer the number of caught individuals was 50. In river Krušnica in the season autumn-winter 30 individuals were caught and in the season spring- summer the number of caught individuals was 78. Based on caught samples, qualitative and quantitative structures of ichthyopopulations of rivers Klokot (Table 1) and Krušnica (Table 2) were made.

**Table 1.** Qualitatively - quantitative structures of the ichthyofauna of the river Klokot in 2001/2002 - summary view

| Family      | No. | Fish species                                | Individuals | %          | Total weight(g) | % mass |
|-------------|-----|---|-------------|------------|-----------------|--------|
| Salmonidae  | 1.  | Brown trout- <i>Salmo trutta m. fario</i> , | 36          | 12,5       | 9 010,5         | 49,1   |
|             | 2.  | Rainbow trout- <i>Oncorhynchus mykiss</i>   | 9           | 3,13       | 627,2           | 3,42   |
| Thymallidae | 3.  | Grayling- <i>Thymallus thymallus</i> ,      | 2           | 0,69       | 1 286,3         | 7,0    |
| Esocidae    | 4.  | Pike- <i>Esox lucius</i> ,                  | 3           | 1,04       | 2 121,7         | 11,5   |
| Cyprinidae  | 5.  | Chub- <i>Leuciscus cephalus</i> ,           | 2           | 0,69       | 1 239,5         | 6,76   |
|             | 6.  | Red-eyed fish- <i>Rutilus rutilus</i> ,     | 31          | 10,8       | 2 451,7         | 13,3   |
|             | 7.  | Pomfret- <i>Rutilus pigus virgo</i> ,       | 3           | 1,04       | 1 083           | 5,91   |
|             | 8.  | Minnow - <i>Phoxinus phoxinus</i> ,         | 186         | 64,8       | 345             | 1,88   |
|             | 9.  | Bleak- <i>Alburnus alburnus</i> ,           | 2           | 0,69       | 47,8            | 0,26   |
| Cottidae    | 10. | Lappet- <i>Cottus gobio</i> ,               | 13          | 4,52       | 102,5           | 0,55   |
| TOTAL       |     |   | <b>287</b>  | <b>100</b> | <b>18 315,2</b> | 100    |

It is visible from the table above that there is in the ichthyofauna of river Klokot a presence of Ten species from five families were found in River Klokot. One species from the Esocidae is found: *Esox lucius* which is caught in both seasons. This species is found in Klokot River, but not in the Una River. Fish from Cyprinidae family were most numerous, in the river Klokot: *Phoxinus phoxinus*, *Rutilus rutilus*, *Rutilus pigus virgo*, *Leuciscus cephalus* and *Alburnus alburnus*, which was by ichthyological research of Una basin first time registered in Klokot, (Sofradžija i sar., 2002). During spring-summer period of 2002 there no bleak and pomfret fish were present. In the river Klokot in both seasons presence of just one species from the Thymallidae was found *Thymallus thymallus*, typical species widely spread in the waters of the Black Sea basin. The Salmonidae, found in both seasons, is represented by two species: *Salmo trutta m. fario* and *Oncorhynchus mykiss*. Cottidae is represented by one species: *Cottus gobio*, and its presence was found in both seasons too.

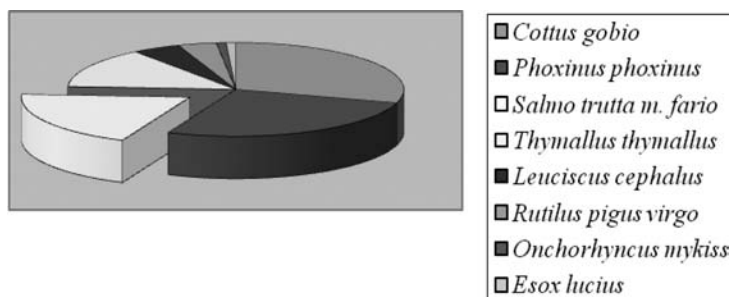
**Figure 2.** The relative number of fish found in the whole sample of river Klokot, summary view

In river Krušnica Salmonidae is represented by two species: *Salmo trutta m. fario*, registered in both seasons and *Oncorhynchus mykiss* which was caught in autumn-winter season 2001, and it was not registered in 2002, spring-summer season. Esocidae is represented by one species *Esox lucius*, which is found only in the spring- summer season, 2002. Thymallidae is represented by *Thymallus thymallus* whose units were found in both seasons.

According to the number of registered species, the most numerous family is Cyprinidae, represented by three species: *Leuciscus cephalus*, *Phoxinus phoxinus* and *Rutilus pigus virgo* found in both seasons, while the chub was caught only in the autumn-winter 2001. Cottidae was represented by *Cottus gobio*, found in both seasons.

**Table 2.** Qualitative-quantitative composition of the ichthyofauna of the river Krušnica in 2001/2002- summary view

| family      | No. | Fish species                                     | Number of units | %          | Total weight(g)  | % mass     |
|-------------|-----|--|-----------------|------------|------------------|------------|
| Salmonidae  | 1.  | Brown trout - <i>Salmo trutta morpha fario</i> , | 21              | 19,4       | 4 347            | 36,3       |
|             | 2.  | Rainbow trout- <i>Oncorhynchus mykiss</i> ,      | 1               | 0,92       | 293,6            | 2,45       |
| Thymallidae | 3.  | Grayling - <i>Thymallus thymallus</i>            | 15              | 13,8       | 2 072,7          | 17,3       |
| Esocidae    | 4.  | Pike - <i>Esox lucius</i> ,                      | 1               | 0,92       | 104,2            | 0,87       |
| Cyprinidae  | 5.  | Chub - <i>Leuciscus cephalus</i> ,               | 5               | 4,62       | 2 168,3          | 18,1       |
|             | 6.  | Pomfret- <i>Rutilus pigus virgo</i> ,            | 4               | 3,7        | 2 551,9          | 21,3       |
|             | 7.  | Minnow- <i>Phoxinus phoxinus</i>                 | 29              | 26,8       | 134,7            | 1,12       |
| Cottidae    | 8.  | Lappet <i>Cottus gobio</i>                       | 32              | 29,6       | 294,9            | 2,46       |
| TOTAL       |     |  | <b>108</b>      | <b>100</b> | <b>11. 967,3</b> | <b>100</b> |



**Figure 3.** The relative number of fish, found in the whole sample of river Krušnica, summary view

If we omit two types that were not found in Krušnica, bleak and red-eyed fish, but occurred in Klokot, we can conclude that of eight species that occur in both rivers, minnow is definitely the most numerous in Klokot, and lappet in Krušnica. Conducted ichthyological research on rivers Klokot and Krušnica, during two seasons, gives us information about the types of fish that are not registered, although they were found in river Una, according to Sofradžija et al. (2002). In Klokot and Krušnica rivers, *Barbus barbus*, *B. meridionalis petenyi*, *Alburnoides bipunctatus*, from the Cyprinidae family, and *Hucho hucho* from Salmonidae family were not found. According to the same research in the tributaries of the Una - Klokot and Krušnica, as well as in the river Una are registered species which occur in all three mentioned biotope: *Salmo trutta m. fario*, *Oncorhynchus mykiss*, *Thymallus thymallus* and *Cottus gobio*. From the previous data, we can conclude that there are no big differences in the qualitative composition of the parent river and its two tributaries. Considering the anthropogenic influence, especially uncontrolled and illegal fishing and the war consequences, as well as industrial and municipal wastewater issue and neglected and solid waste around these rivers, the presence of established number of fish in the whole sample gives satisfying results.

## CONCLUSION

According to analysis in this paper and the overall results obtained in ichthyofaunistic study of aquatic ecosystems of river Klokot and Krušnica, which were made in the course of two seasons, autumn - winter 2001 and spring - summer 2002, with the application of a standard fishing tools, it is possible to bring out several important conclusions: It was determined that ten species of fish, which are grouped into five families: Salmonidae, Cyprinidae, Esocidae, Thymallidae and Cottidae inhabit Klokot, and eight species of fish also classified in these five families, inhabit river Krušnica. In the ichthyofauna of rivers Klokot and Krušnica families Esocidae, Thymallidae, Cottidae are presented by one species *Esox lucius*, *Thymallus thymallus*, *Cottus gobio*. Salmonidae was represented with two species in Klokot and Krušnica, *Salmo trutta m. fario* and *Oncorhynchus mykiss*. Cyprinidae is the most numerous in the both rivers, and it is represented by 5 species in the river Klokot: *Leuciscus cephalus*, *Phoxinus phoxinus*, *Alburnus alburnus*, *Rutilus pigus virgo*, *Rutilus rutilus*. In the river Krušnica Cyprinidae is represented with three species which also appear in Klokot, with the exceptions of fish *Rutilus rutilus*, *Alburnus alburnus*. Considering insufficient exploration of water and river flows in the Una-Sana Canton, it is necessary to make an inventory of ichthyofauna of aquatic ecosystems which are part of Una-Sana Canton waters. In order to take concrete measures of protection, of indigenous fish populations primarily, it is necessary to prevent an unplanned fish stocking, importation of new species and uncontrolled and illegal fishing; this was also recommended within the monitoring and research of aquatic biotopes. In future the research of ichthyofauna of rivers Klokot and Krušnica should be expanded to four seasons; autumn, winter, spring and summer, and on the longitudinal profile of these rivers at least six locations should be chosen for ichthyological studies.

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